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## ABSTRACT

Advancement in computer technology comes at a time when agriculture is in transition from a production-oriented to a business-oriented activity and will require new skills and knowledge if farmers are to be prepared for the future. Electronic technology applications on 21st century commercial farms and ranches will include farm decision support systems, monitoring and data logging for information systems, robots and electronic control of machines and irrigation systems, communications, and continuing education. Information on the latest technologies and access to rural and international libraries for education and entertainment will be possible by linking on-farm computers with two-way satellite communication. Educational activities must be changed to recognize the increasingly important role of women on the farms of the future since women will play a larger role in computerized farm and ranch management and must be better trained in accounting, economics, and finance to complement the use of computerized tools. The Cooperative Extension Service will face major challenges because of its primary role in education and information generation and delivery. The Year 2000 Computerized Farm Project operates a 3,300 acre demonstration farm and ranch to facilitate testing and evaluation of computer applications in a commercial farm setting. (BRR)

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COMPUTERIZED FARM OF THE 21ST CENTURY

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COMPUTERIZED FARM OF THE 21ST CENTURY  
James M. McGrann\*

By the beginning of the 21st century, computers will be widely used in U.S. commercial agriculture. There will be few managerial, production and living activities that will not use products of the electronic age. The force behind the widespread adoption of the technology will be the economic incentives to remain competitive in domestic and foreign markets and the low cost of computer technology that has many applications. There also will be highly skilled human resources at the farm level that have learned to effectively utilize large amounts of information in decision making. There will be a strong education program supported by electronic technology in rural areas.

The present advancement in computer technology comes at a time when agriculture is in a transition from a production to a business oriented activity. To cope with high cost of capital, a continued cost price squeeze and instability in commodity prices, farm decision makers must improve management skills and learn to use computer tools to facilitate them in decision making. This is a dynamic change requiring new skills and knowledge for farmers to be prepared for the future.

This paper identifies areas of electronic technology use on the 21st century farms. The Texas A & M University Year 2000 computerized farm project is described. Some of the changes in land grant research and extension activities required to support research and education needs for the 21st century computerized farmers are identified.

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### Uses of Computers on the 21st Century Farms

One should not separate computers out as a separate component of electronic technology that includes satellite communications, electronically accessible data bases and libraries, to name a few of the technologies. The computer is, however, the center of activity and the technology that is making the real difference for some time to come.

Electronic technology applications on the 21st century commercial farms and ranches can be outlined as follows.

#### A. Farm decision support systems

1. Management information supplied through on-farm accounting, performance records and off-farm information data bases and networks. Most will be controlled by verbal responses.
2. Computerized decision aids using artificial intelligence in diagnostic activities in areas of pest control, financial and marketing analysis.
3. Integrated information and decision support systems where information generation and decision making activities minimize data entry and fit individual manager needs.

#### B. Monitoring, data logging, controlling and robots

1. Most production activities, monitoring and data logging for information systems will be generated electronically with a variety of computer and communication technology.
2. Many of the labor intensive activities will be replaced by robots and electronic controlling, ie. tractors, machines and irrigation systems will operate automatically from control centers.

3. Weather information and building temperatures will be monitored and data entered directly in the decision support systems and appropriate action will automatically be taken in responding to many conditions.
4. Animal health and production will be monitored by electronic sensors that are linked into decision support systems.

C. Communications

1. Mail, business and marketing transactions will be made electronically.
2. Two way video communication will be as common as today's telephone.

D. Continued education

1. Information on the latest technologies and access to international libraries for education and entertainment will be made possible by linking the on-farm computer with two-way satellite communication. These systems will be aimed at meeting a full range of family educational and entertainment needs.
2. Computerized networks using satellites will provide rural access to libraries. These systems will be supported by expert systems that help the user get through enormous amounts of information and focus on specific information needs to address the problem in question.

This outline summarizes the general areas of electronic technology applications. Some are a reality today by innovative and highly skilled producers. A great deal of applied research will be required to bridge the gap between technology in the lab and its practical use on the farm.

Preparing the human resources to use the new technologies offers an even greater challenge.

#### The Users of Computer Technology

Current estimates are somewhere between 5-10 percent of the U.S. farmers and ranchers that have on-farm computers. Early adoptors are the larger, better educated farmers and ranchers [Yarbrough]. By the Year 2000, most commercial farmers will use computer technology. This group of producers who make a majority of their income from farming or ranching do account for most of agricultural production and sales. In 1982, 12.3% of the U.S. farms with sales over \$100,000 accounted for 68 percent of agriculture sales. Less than 5 percent with sales over \$200,000 accounted for almost half of U.S. agriculture sales [USDA, 1982]. Economic focus will likely continue to move American agriculture toward fewer farms. These large commercial farms will be the first group that will be the most active participants and gain from the application of electronic technology that is combined with highly trained human resources.

Adoption of computer technology in agriculture is not going to have a big impact on employment numbers; after all, there are not that many farmers left. The technology will change the type of work, skills and knowledge required by commercial farm operators. Attitudes toward "what is work" will have to continue to change. This is difficult for such producers, as are some of our Texas cowboys, who really do not feel office work is "real work". Changes in life styles always present adjustment opportunities that new generations can more willingly accept.

Women will play a larger role in farm and ranch management through their active involvement in the computerized farm. Operation of the farm is going

to be much more centered around the information system than production activities. Women must be better trained in accounting, economics and finance to complement the use of computerized tools. Educational activities must be changed to recognize the increasingly important role of women in the farms of the future.

Texas A & M University has initiated a project that will link the application, training and demonstration of computer technology on commercial farms. The following section describes this effort.

#### The Texas A&M Year 2000 Computerized Farm Project

In December of 1983, the Texas Agricultural Extension Service and the Texas Agricultural Experiment Station, agencies of the Texas A&M University System, initiated a project to develop a Year 2000 Computerized demonstration farm. This two million dollar project is supported by a \$500,000 grant from the W.K. Kellogg Foundation, a \$285,000 computer hardware and software grant from Texas Instruments, Inc. and a training center that was built through support of the Stiles Farm Foundation. The John Deere Corporation has supplied a tractor to demonstrate computer applications for monitoring tractor performance and automated data generation for machinery management. Private software vendors have contributed software to the project to be used at the farm and for user training.

The project involves establishing a full-fledged computer training center at the Stiles farm, a 3,300-acre site operated as a demonstration farm and ranch for the Central Texas Blacklands area. Some 2,000 acres of the farm are devoted to crops. The remainder supports pastures, waterways, ponds, and the farm headquarters. The farm is greatly diversified, producing cotton, corn, grain, sorghum, wheat, oats, vegetables, hay, cattle, swine, and catfish.

The purpose of the computerized farm project is to apply computer technology to all aspects of a commercial-size farming operation. The project will test and demonstrate computer technology on the Stiles Farm to its full potential. It will provide computer application experience that can be transferred directly to other commercial farms and ranches. The Stiles Farm computer training center is equipped with 11 microcomputers and has a 22 person capacity for in-depth computer application training. The software library is being developed from private sector software vendor donations, Texas A&M software and software from other states. Short courses will be presented to allow for in-depth educational effort on specific applications of computers.

Farm application of computers will facilitate testing and evaluation of computer applications in a commercial farm setting. This effort will serve as a "real world" demonstration to producers and agribusinesses who are increasing their awareness on how to profitably use computers.

During the three-year period, computers will be brought into the Stiles Farm's total management information system. This will serve as a centralized effort for multidisciplinary involvement of extension and research staff in computer and other electronic technology applications. Although the primary focus is on applications that are commercially viable to farmers and ranchers, a certain number of applications still in the experimental stage of development will be applied and demonstrated.

A farmer user group will be organized in the area to compliment the computerized farm effort. This will facilitate learning more how farm management decisions are made and about the human adjustment related problems associated with computer adoption. It will also help identify flexibility that must be incorporated into decision support systems and uses education

needs for a variety of farm and human resource situations.

Project results will be demonstrated to farmers, ranchers, agribusiness firms and educators during short courses, farm tours and field days and visits by special delegations. The computerized farm system will become an ongoing part of the Stiles Farm's efforts to support the advancement of agricultural technology.

#### Changing Activities of Research and Extension

The role of the experiment station will not be altered a great deal by the adoption of on-farm computer technology. The experiment station will still be the center of agricultural research. Pressures will increase for more biological, engineering and economic research because of the tremendous increase in analytical and information use capacity with the use of on-farm computers. The period of time between development of new technology and adoption will be shortened because evaluation and information generation will be facilitated by computer technology. An expanding field of agriculture research will be developing decision support systems and other computer uses identified in the first section of this paper.

The Cooperative Extension Service faces major challenges because of its primary role in education and information generation and delivery. Commercial agricultural information and education needs of both the women and men involved in decision making will change and the information delivery system will be altered by electronic technology.

The current leadership in application of computers on commercial farms and ranches is by private software vendors. The large amount of service required for effective computer use and the ability of the private sector to package and market software will reinforce this position over time. The

private sector, however, will continue to draw upon the experiment station research for most of the biological and engineering relationships incorporated into software.

The extension service and experiment station will continue to develop decision aids that require interdisciplinary teams of specialists and software not available in the private sector due to its potentially limited market. This will be repackaged and marketed by private sector vendors.

The greater demand for extension support in the information age will be in subject matter education (accounting, economics, finance, animal nutrition, etc.). There will be no shortage of hardware and software for agriculture. The problem will be the lack of subject matter knowledge to complement the computerized tools.

Extension will be required to change its educational format and delivery systems, retrain staff and target audiences if it is to be successful in the electronic age. Some trends that can be observed today point in the direction of change. Many of the innovative producers bypass the county agent and go directly to specialists or the researchers. These producers do not go to extension meetings but attend intensive workshops, provided in the private sector, paying large fees for education targeted at their needs. National agricultural information networks in the private sector are expanding to meet farmers' perishable information needs. One of the greatest subject matter weaknesses of the Cooperative Extension Service is in economics, finance and management - a critical need of farmers. Change will be necessary to make Extension responsive to clientele specific subject matter needs.

Budgetary cuts combined with growing needs to purchase hardware and software to upgrade extension staff offices, retrain staff and expand new education needs do not mix well. Tight budgets call for detailed need

assessment studies, setting priorities, dropping old programs and targeting efforts.

It is anticipated that over time extension will change the educational format to at least multi-day workshops, learn to more effectively use electronic information delivery systems available in the private sector as well as those maintained by the land grant institutions. The organization's need for legislative support from commercial agriculture will force programming efforts to expand to meet educational needs. By the beginning of the 21st century a specialized group of extension staff, most with joint extension and research appointments, will work with commercial agriculture. Either this will be a separate activity from the extension organization with its broad audience or there will be a separate public organization aimed specifically at commercial agriculture educational support needs.

Over time the phase of technology development that dominates today computers use will evolve into the human side of the question - productivity and satisfaction. Extension's link to the decision maker offers an opportunity for an important contribution in applying and directing the technology.

#### Areas of Research Need

Development of useful software and computerized information systems for decision support systems require a great deal more understanding of the decision making process in agriculture. The capabilities of today's technology are beyond the knowledge of how to effectively improve the decision process through computer applications. In general, the management information systems built for management have not been effective because they do not take into account the human aspect of decision making [Keen and Scott]. If

effective computer systems are to be developed, more research on the decision making process in agriculture is needed.

To be responsive to rapid change, research needs to be done to determine a more effective program evaluation procedure for extension so programs can be dropped to add more effective new programs. Reduced funding requires more precise measurement of productivity and priority selection.

The Cooperative Extension Service has an extremely broad spectrum of activities and clientele. Many activities are only remotely related to commercial agriculture today. Perhaps it would be valuable to study the mission and direction of extension so an effective program can be maintained for commercial producers that today frequently bypass the county agent and go directly to specialists or researchers for educational information.

Scientific objectivity is the key to long term success of public research and extension. It would be valuable to study the type of research and extension organization best suited for meeting the need for objectivity, while serving fewer farmers with a greater interdependency with the private sector in the information age.

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